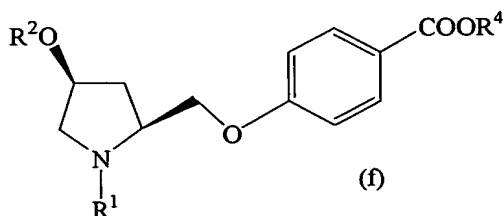


Claims

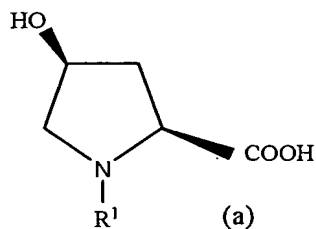
1. A method for producing a compound represented by formula (f):

[F6]



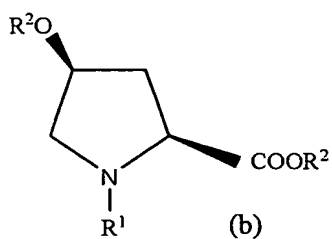
(wherein R^1 represents a protecting group for the amino group, R^2 represents a lower alkyl group, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted), characterized by comprising reacting an alkyl halide with a compound represented by formula (a):

[F1]



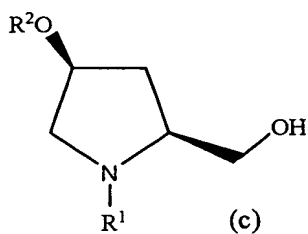
(wherein R^1 has the same meaning as defined above)
in the presence of a base to thereby produce a compound represented by formula (b):

[F2]



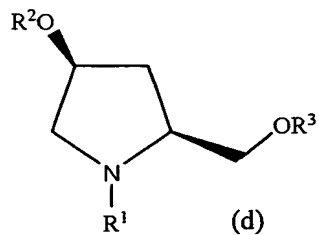
(wherein R^1 and R^2 have the same meanings as defined above);
 reacting a reducing agent with the compound represented by
 formula (b) to thereby produce a compound represented by
 formula (c):

[F3]



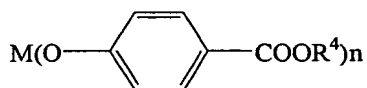
(wherein R^1 and R^2 have the same meanings as defined above);
 reacting the compound represented by formula (c) with an
 arylsulfonyl halide which may be substituted or an
 alkylsulfonyl halide which may be substituted in the presence
 of a base to thereby produce a compound represented by
 formula (d):

[F4]



(wherein R^1 and R^2 have the same meanings as defined above, and R^3 represents an arylsulfonyl group which may be substituted or an alkylsulfonyl group which may be substituted); and reacting the compound represented by formula (d) with a compound represented by formula (e):

[F5]



(e)

(wherein R^4 has the same meaning as defined above, M represents an alkali metal atom or an alkaline earth metal atom, and n denotes an integer of 1 or 2).

2. A method according to claim 1, wherein R^1 represents a benzyloxycarbonyl group.

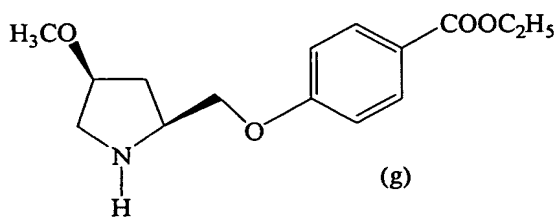
3. A method according to claim 1 or 2, wherein R^2 represents a methyl group or an ethyl group.

4. A method according to any one of claims 1 to 3, wherein R^3 represents a para-toluenesulfonyl group or a methanesulfonyl group.

5. A method according to any one of claims 1 to 4, wherein the arylsulfonyl halide or the alkylsulfonyl halide is an arylsulfonyl chloride or an alkylsulfonyl chloride.

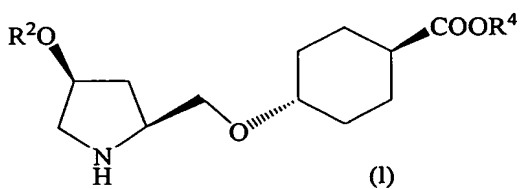
6. An oxalic acid salt of the compound represented by formula (g).

[F7]



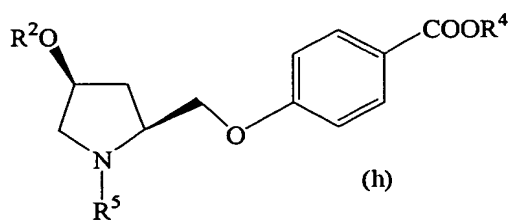
7. A method for producing a compound represented by formula (1):

[F12]



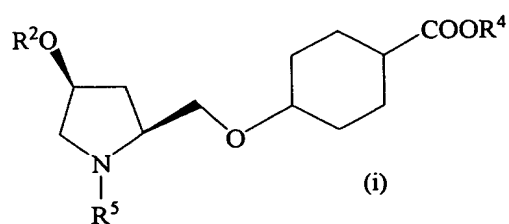
(wherein R^2 represents a lower alkyl group, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted), characterized by comprising reducing a compound represented by formula (h):

[F8]



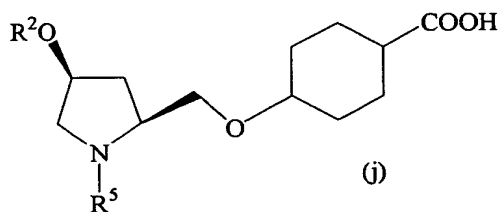
(wherein R^2 and R^4 have the same meanings as defined above, and R^5 represents a hydrogen atom or a protecting group for the amino group) to thereby produce a compound represented by formula (i):

[F9]



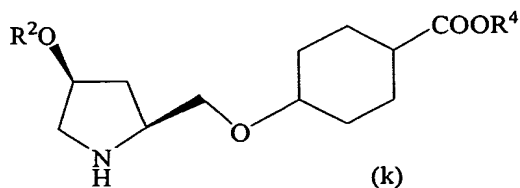
(wherein R^2 , R^4 , and R^5 have the same meanings as defined above); treating the compound represented by formula (i) with a base in an aprotic polar solvent and then reacting with water to thereby produce a compound represented by formula (j):

[F10]



(wherein R^2 and R^5 have the same meanings as defined above); and treating the compound represented by formula (j) with an acid in the presence of an alcohol to thereby produce a compound represented by formula (k):

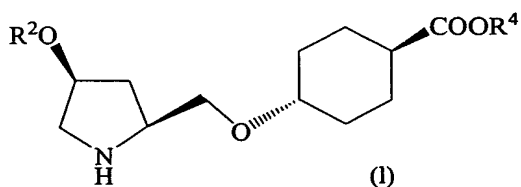
[F11]



(wherein R^2 and R^4 have the same meanings as defined above);
 and treating the compound represented by formula (k) with
 camphorsulfonic acid to thereby form an acid adduct salt so
 that an isomer of interest can be isolated.

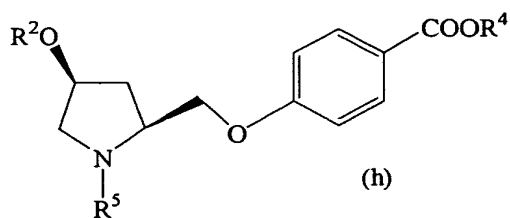
8. A method for producing a compound represented by
 formula (l):

[F16]



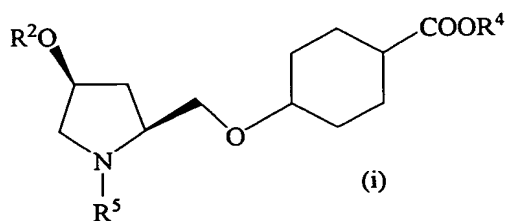
(wherein R^2 represents a lower alkyl group, and R^4 represents
 an alkyl group which may be substituted or an aralkyl group
 which may be substituted), characterized by comprising
 reducing a compound represented by formula (h):

[F13]



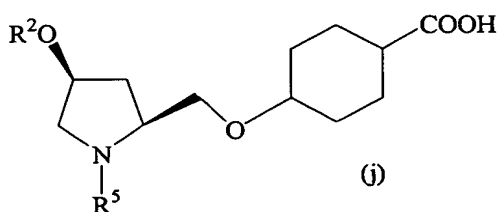
(wherein R^2 and R^4 have the same meanings as defined above,
 and R^5 represents a hydrogen atom or a protecting group for
 the amino group) to thereby produce a compound represented by
 formula (i):

[F14]



(wherein R^2 , R^4 , and R^5 have the same meanings as defined above); treating the compound represented by formula (i) with a base in an aprotic polar solvent and then reacting with water to thereby produce a compound represented by formula (j):

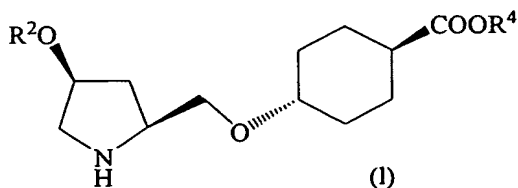
[F15]



(wherein R^2 and R^5 have the same meanings as defined above); and treating the compound represented by formula (j) with camphorsulfonic acid to thereby form an acid adduct salt so that an isomer of interest can be isolated.

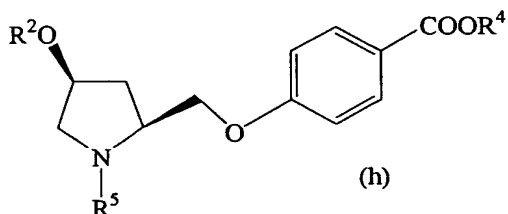
9. A method for producing a compound represented by formula (l):

[F21]



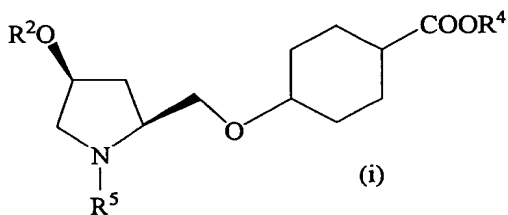
(wherein R^2 represents a lower alkyl group, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted), characterized by comprising reducing a compound represented by formula (h):

[F17]



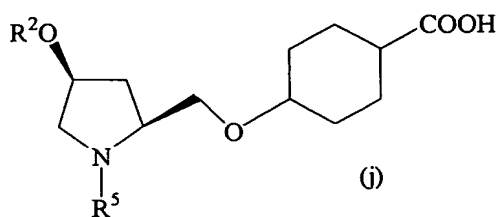
(wherein R^2 and R^4 have the same meanings as defined above, and R^5 represents a hydrogen atom or a protecting group for the amino group) to thereby produce a compound represented by formula (i):

[F18]



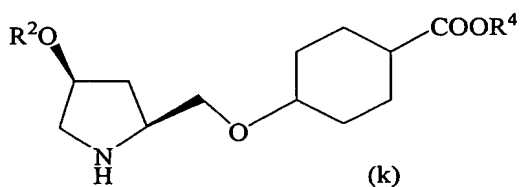
(wherein R^2 , R^4 , and R^5 have the same meanings as defined above); treating the compound represented by formula (i) with a base in an aprotic polar solvent and then reacting with water to thereby produce a compound represented by formula (j):

[F19]



(wherein R^2 and R^5 have the same meanings as defined above);
isolating the compound represented by formula (j) as a salt
and then treating the salt with an acid in the presence of an
alcohol to thereby produce a compound represented by formula
(k):

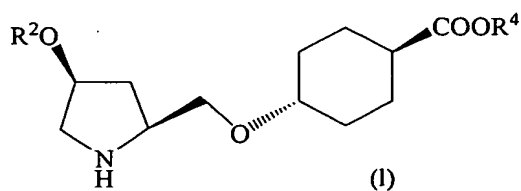
[F20]



(wherein R^2 and R^4 have the same meanings as defined above);
and treating the compound represented by formula (k) with
camphorsulfonic acid to thereby form an acid adduct salt so
that an isomer of interest can be isolated.

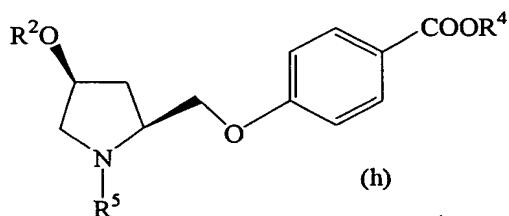
10. A method for producing a compound represented by
formula (l):

[F25]



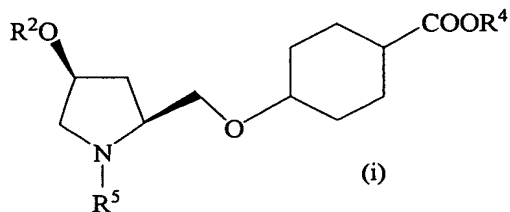
(wherein R^2 represents a lower alkyl group, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted), characterized by comprising reducing a compound represented by formula (h):

[F22]



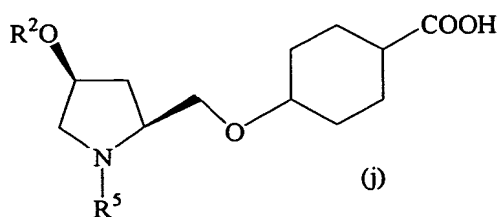
(wherein R^2 and R^4 have the same meanings as defined above, and R^5 represents a hydrogen atom or a protecting group for the amino group) to thereby produce a compound represented by formula (i):

[F23]



(wherein R^2 , R^4 , and R^5 have the same meanings as defined above); treating the compound represented by formula (i) with a base in an aprotic polar solvent and then reacting with water to thereby produce a compound represented by formula (j):

[F24]



(wherein R^2 and R^5 have the same meanings as defined above); isolating the compound represented by formula (j) as a salt and then treating the compound with camphorsulfonic acid to thereby produce an acid adduct salt so that an isomer of interest can be isolated.

11. A method according to any one of claims 7 to 10, wherein the compound represented by formula (h) is a compound produced through a method according to claim 1, a compound produced through removal of the protecting group for the amino group of a compound produced through a method according to claim 1, or a compound produced through removal of the protecting group for the amino group of a compound produced through a method according to claim 1 and then protection of the amino group with a protecting group which differs from the removed protecting group.

12. A method according to any one of claims 7 to 11, wherein R^5 represents a tert-butoxycarbonyl group.

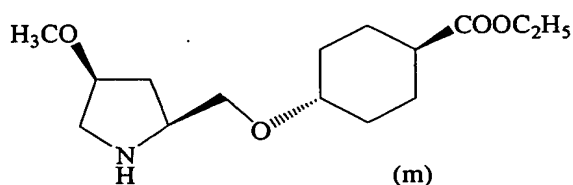
13. A method according to any one of claims 7 to 12, wherein R^4 represents a methyl group or an ethyl group.

14. A method according to any one of claims 7 to 13, wherein the base is sodium hydride, lithium hydride, or potassium t-butoxide.

15. A method according to any one of claims 7 to 14, wherein the aprotic polar solvent is N,N-dimethylformamide or N,N-dimethylacetamide.

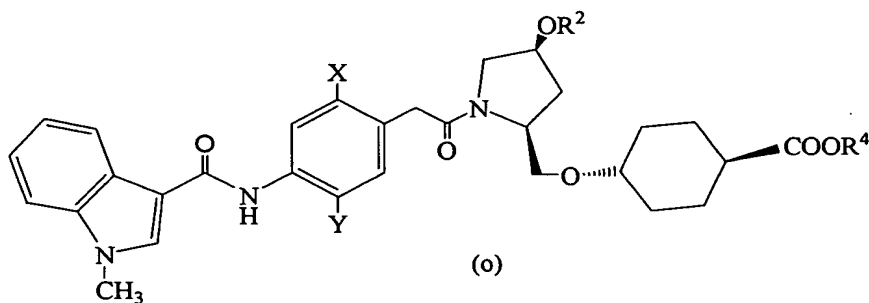
16. A camphorsulfonic acid salt of the compound represented by formula (m).

[F26]



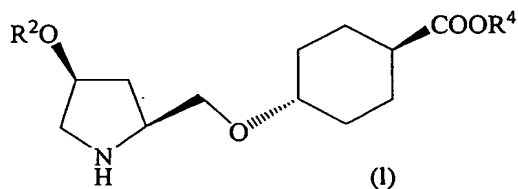
17. A method for producing a compound represented by formula (o):

[F29]



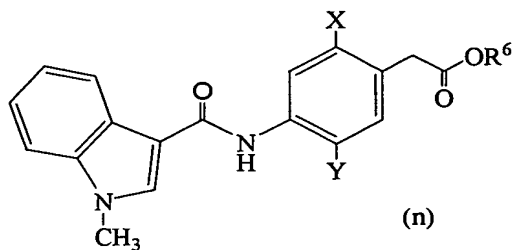
(wherein R^2 represents a lower alkyl group, R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted, X represents a hydrogen atom or a halogen atom, and Y represents a halogen atom or a lower alkoxy group), characterized by comprising reacting a compound represented by formula (1):

[F27]



(wherein R^2 and R^4 have the same meanings as defined above)
 produced through a method according to any one of claims 7 to
 10, with a compound represented by formula (n):

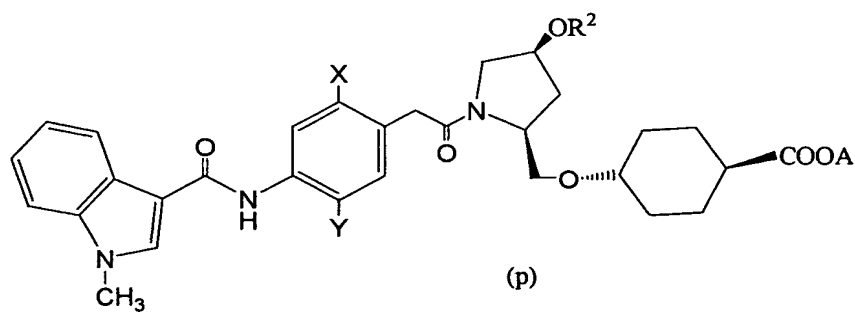
[F28]



(wherein R^6 represents a hydrogen atom, a linear or branched
 lower alkyl group which may be substituted, or an aralkyl
 group which may be substituted, and X and Y have the same
 meanings as defined above).

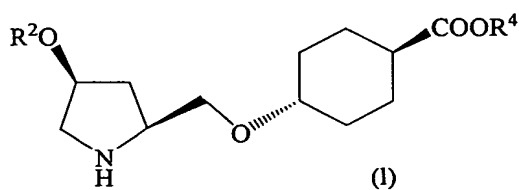
18. A method for producing a compound represented by
 formula (p):

[F33]



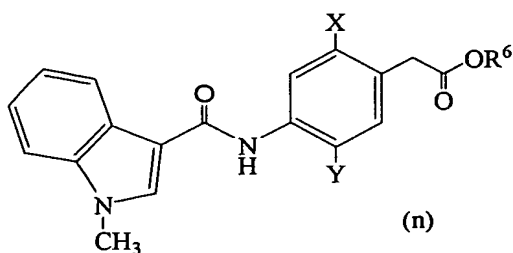
(wherein R^2 represents a lower alkyl group, A represents a hydrogen atom, an alkali metal atom, an alkaline earth metal atom, or an organic amine, X represents a hydrogen atom or a halogen atom, and Y represents a halogen atom or a lower alkoxy group) or a hydrate thereof, characterized by comprising reacting a compound represented by formula (1):

[F30]



(wherein R^2 has the same meaning as defined above, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted) produced through a method according to any one of claims 7 to 10, with a compound represented by formula (n):

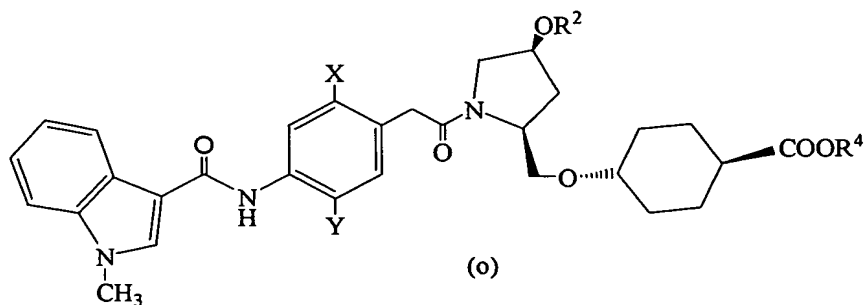
[F31]



(wherein R^6 represents a hydrogen atom, a linear or branched lower alkyl group which may be substituted, or an aralkyl group which may be substituted, and X and Y have the same

meanings as defined above) to thereby produce a compound represented by formula (o):

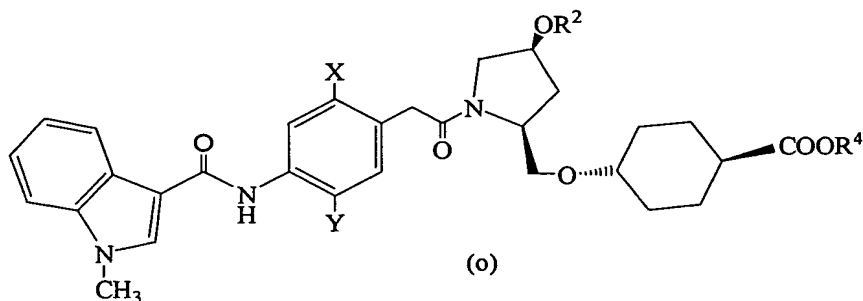
[F32]



(wherein R², R⁴, X, and Y have the same meanings as defined above); and hydrolyzing the compound represented by formula (o).

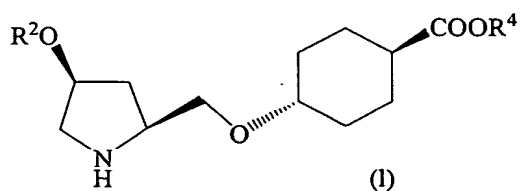
19. A method for producing a compound represented by formula (o):

[F38]



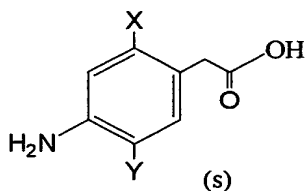
(wherein R² represents a lower alkyl group, R⁴ represents an alkyl group which may be substituted or an aralkyl group which may be substituted, X represents a hydrogen atom or a halogen atom, and Y represents a halogen atom or a lower alkoxy group), characterized by comprising reacting a compound represented by formula (1):

[F34]



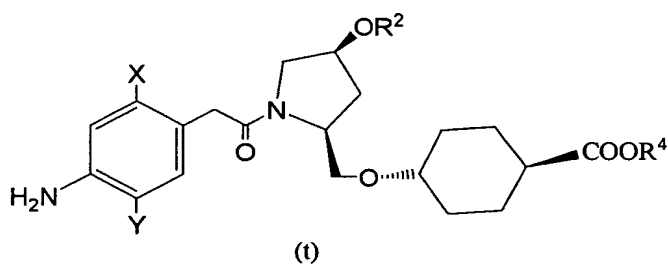
(wherein R^2 and R^4 have the same meanings as defined above)
produced through a method according to any one of claims 7 to
10, with a compound represented by formula (s):

[F35]



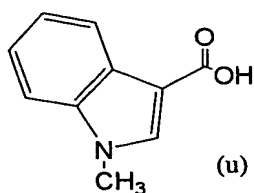
(wherein X and Y have the same meanings as defined above) to
thereby produce a compound represented by formula (t):

[F36]



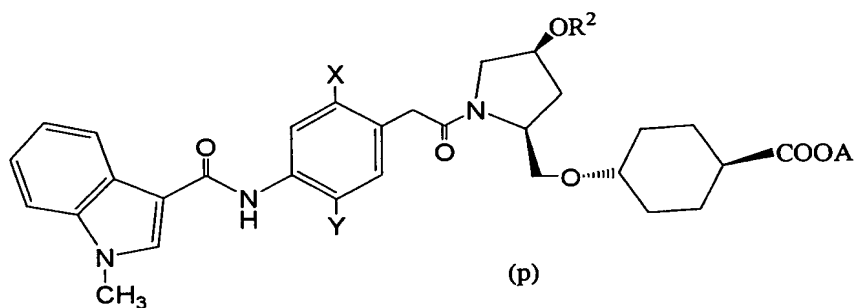
(wherein R^2 , R^4 , X , and Y have the same meanings as defined
above); and reacting the compound represented by formula (t)
with a compound represented by formula (u).

[F37]



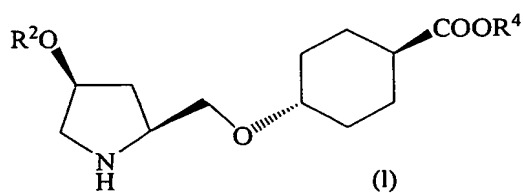
20. A method for producing a compound represented by formula (p):

[F44]



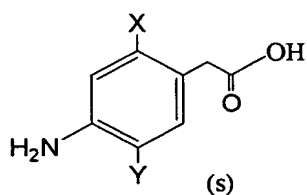
(wherein R^2 represents a lower alkyl group, A represents a hydrogen atom, an alkali metal atom, an alkaline earth metal atom, or an organic amine, X represents a hydrogen atom or a halogen atom, and Y represents a halogen atom or a lower alkoxy group) or a hydrate thereof, characterized by comprising reacting a compound represented by formula (l):

[F39]



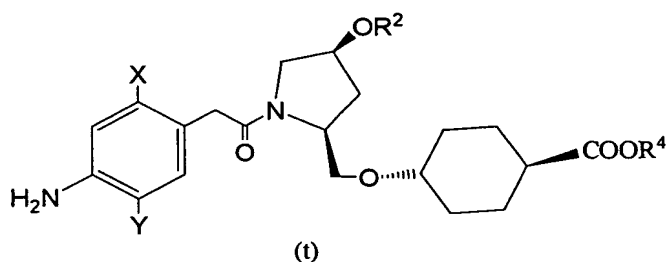
(wherein R^2 has the same meaning as defined above, and R^4 represents an alkyl group which may be substituted or an aralkyl group which may be substituted) produced through a method according to any one of claims 7 to 10, with a compound represented by formula (s):

[F40]



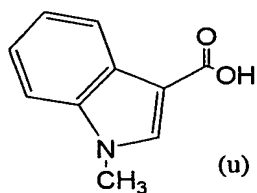
(wherein X and Y have the same meanings as defined above) to thereby produce a compound represented by formula (t):

[F41]



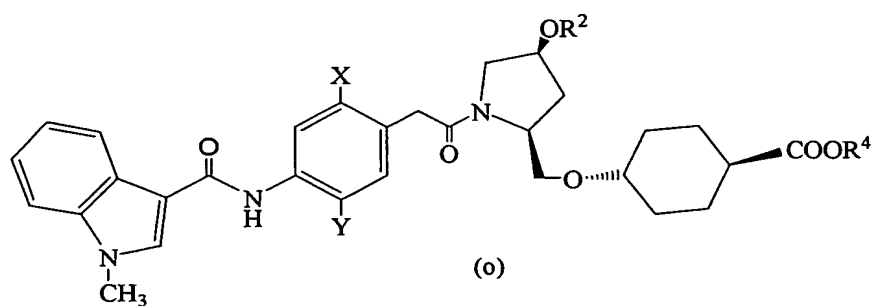
(wherein R^2 , R^4 , X, and Y have the same meanings as defined above); reacting the compound represented by formula (t) with a compound represented by formula (u):

[F42]



to thereby produce a compound represented by formula (o):

[F43]



(wherein R^2 , R^4 , X, and Y have the same meanings as defined above); and hydrolyzing the compound represented by formula (o).

21. A method according to any one of claims 17 to 20, wherein R^2 represents a methyl group or an ethyl group.

22. A method according to any one of claims 17 to 21, wherein X represents a chlorine atom or a fluorine atom.

23. A method according to any one of claims 17 to 22, wherein each of X and Y represents a chlorine atom.

24. A method according to any one of claim 18 and claims 20 to 23, wherein A represents sodium.